GAMETH®

A Process Modeling Approach to Identify and Locate Crucial Knowledge

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ABSTRACT

In a knowledge management initiative, one of the main issues is to identify and locate which knowledge to capitalize on. To deal with this issue, a General Analysis Methodology so called GAMETH® has been developed. In this article, we describe the postulates, the guiding principles, and the main phases, which constitute the basis of GAMETH® Framework. Notably, we emphasize the process modeling approach that is inherent to the second phase of the methodology. This process modeling approach supports the effective capability to locate and identify "crucial knowledge". Furthermore, we present lessons learned from two case studies.

Keywords:

Crucial knowledge, GAMETH®, Identifying and Locating Company's Crucial Knowledge, Knowledge Management, Process modeling.

1. INTRODUCTION

One of the main issues in a knowledge management initiative is to locate and identify essential knowledge to capitalize on. Thomas A. Stewart pointed out this issue as early as 1991 [1]. In his article, Tom Stewart warned companies for the first time "*intellectual capital is becoming corporate America's most valuable asset and it can be its sharpest competitive weapon. The challenge is to find what you have – and use it.*" Since that time, companies launched numerous KM initiatives. However, in his last work [2] the same author notices the fatal effect of technology oriented KM initiatives not subjected to advisability studies. He states, "*One flaw in knowledge management is that it often neglects to ask what knowledge to manage and to what end*" (p. 117).

Thus, the problem stakeholders must face is to identify which knowledge justifies a KM initiative. This means developing an approach enabling to identify and locate crucial knowledge. To deal with this issue, a Global Analysis Methodology so-called GAMETH® has been developed. In this paper, after having defined the concept of "crucial knowledge," we describe the GAMETH® Framework emphasizing on the postulates and the process modeling approach that are used. Finally, we present lessons learned from two case studies.

2. BACKGROUND THEORY AND ASSUMPTIONS

The concept of "crucial knowledge"

Crucial knowledge supplies essential resources that are used by value-adding processes of a company.

Value-adding processes derive from the value chain described by Porter [3] who identifies nine value-adding activities that he classifies into two main categories. The "*primary activities*" are: 1) in-bound logistics, 2) operations, 3) out-bound logistics, 4) marketing & sales, and 5) Services. The "*support activities*" are: 1) business infrastructure, 2) human resource management, 3) technological development, and 4) supplies. In this way, Value-adding processes represent the organizational context for which knowledge is an essential factor of performance. It is in this context that is implanted a KM initiative. As pointed out by Tonchia and Tramontano [4] "*Process Management, with the concepts of internal customers and process ownership, is becoming one of the most important competitive weapons for firms and can determine a strategic change in the way business is carried out.*" These authors state, "*Process Management consists in the rationalization of processes, the quest for efficiency-effectiveness, a sort of simplification-clarification brought about by common-sense engineering*" (p. 20). As Process Management engenders structural changes, when doing Business Process Reengineering we should consider KM activities in order to identify knowledge that is essential factor to enable value-adding processes to achieve their goals efficiently. This knowledge will be crucial depending of a multi criteria analysis [5]. Notably, knowledge will be "crucial knowledge" depending of its degree of vulnerability, and its impact on the objectives and the durability of the firm.

For example, such is the case for knowledge characterized as follow:

- Knowledge is rare, specific and unique, imperfectly diffused, non- substitutable, difficult to pass down;
- The cost to develop or purchase that knowledge is very high and the period required getting it is long;
- Possible loss of that knowledge can cause an unacceptable risk for the strategy and life durability of the firm, by weakening its core competencies, endangering the performances of its business units and reducing its market share.

Company's crucial knowledge can be tacit, or explicit following the definitions states by Nonaka *et al* [6] (p. 7).

The KM Processes to Capitalize On Company's Knowledge

The KM processes answer the problem of capitalizing on company's knowledge defined in the following way [7]:

> "Capitalizing on company's knowledge means considering certain knowledge used and produced by the company as a storehouse of riches and drawing from these riches interest that contributes to increasing the company's capital" (p. 263).

Several problems co-exist. They are recurring problems for a company. These problems constitute a general problematic that has been organized in five categories. Each of these categories contains sub-processes aimed to contribute a solution to the set of overall problems. Thus, we have identified four KM Processes corresponding to the resolution of these categories of problems (cf. figure 1). We describe these processes below.

The Locating KM Process deals with the location of Crucial Knowledge, that is, Knowledge (explicit or tacit) that is essential for decision-making processes and for the progress of the value-adding processes. It is necessary to identify it, to locate it, to characterize it, to map it, to estimate its economic value, and to classify it.

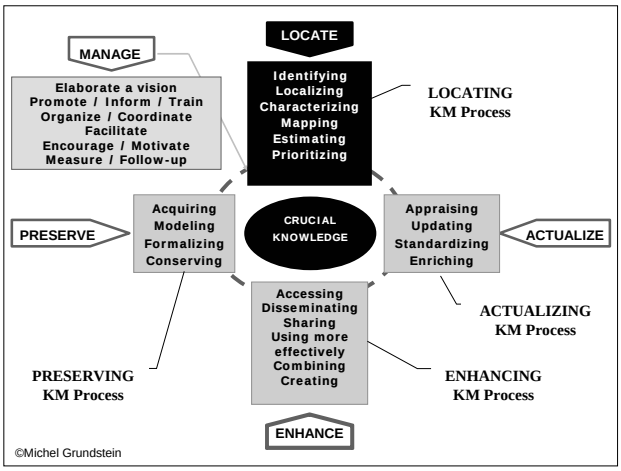

Figure 1: KM Processes to capitalize on company's knowledge

The *Preserving KM Process* deals with the preservation of know-how and skills. When one can articulate knowledge, it is necessary to acquire it with the bearers of knowledge, to represent it, to formalize it, and to conserve it. This leads to Knowledge Engineering activities notably described in Schreiber *et al* [8], and Charlet *et al* [9]. When formalizing knowledge is not feasible, then interactions through communities of practice or other types of networks must be encouraged.

The *Enhancing KM Process* deals with the added-value of know-how and skills: it is necessary to make them accessible according to certain rules of confidentiality and safety, to disseminate them, to share them, to use them more effectively, to combine them, and to create new knowledge. Here is the link with innovation processes.

The *Actualizing KM Process* deals with the actualization of know-how and skills: it is necessary to appraise them, to update them, to standardize them and to enrich them according to the returns of experiments, the creation of new knowledge, and the contribution of external knowledge. Here is the link with business intelligence processes.

3. THE GAMETH® FRAMEWORK

The GAMETH® Framework [7] is one of the results of the project untitled CORPUS initiated and led from 1991 to 1995 into the Framatome Group[1]. The scope of CORPUS was to elaborate a set of concepts, methods and tools aimed at contributing to capitalizing on company's knowledge assets. At the beginning, CORPUS deliverable was a complementary approach to manage the advisability phase of an information project with the aim of integrating knowledge capitalization functionalities into the specifications [10]. Later on, we have considered generalizing this approach, and since 1997, it has been consolidated as a General Analysis Methodology, the so-called GAMETH® Framework (cf. figure 2).

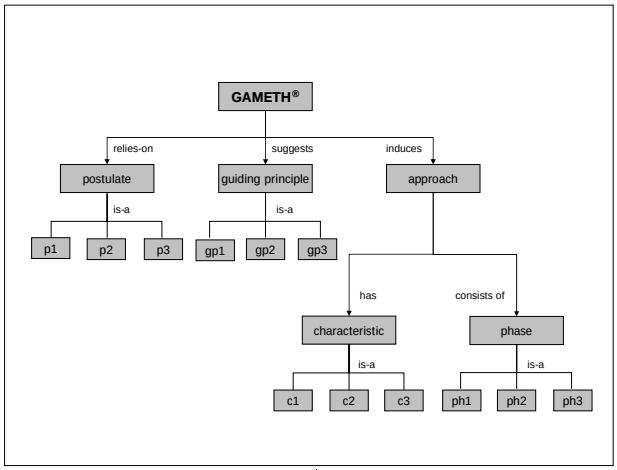

Figure 2: GAMETH® Framework Representation

The GAMETH® Framework fits with the "Locating KM Process" described above. Thus, GAMETH® provides the elements that lead to identifying the problems, clarifying the needs for knowledge, identifying and locating potential crucial knowledge, specifying the value-based assessment of this knowledge, and finally, determining "crucial knowledge".

[1] French Nuclear Power Plant Company, first transformed into Framatome ANP then integrated into AREVA Group in September 2001.

GAMETH® relies on three postulates (p1, p2, p3), suggests three guiding principles (gp1, gp2, gp3), induces an approach that has three specific characteristics (c1, c2, c3) and consists of three main phases (ph1, ph2, ph3).

The postulates

The following postulates underlie the GAMETH® Framework

Postulate p1: Company's knowledge includes two main categories of knowledge

Within a company, knowledge consists of two main categories – cf. table 1). On the one hand, explicited knowledge includes all tangible elements (we call it "know-how") and, on the other hand, tacit knowledge [11], includes intangible knowledge (we call it "skills"). The tangible elements take the shape of formalized knowledge within a physical media (procedures, plans, models, algorithms, and analysis and synthesis documents), and/or the shape of codified knowledge (knowledge-based systems, databases). They also are embedded in automated management systems, in conception and production systems, and in products. The intangible elements are inherent to the individuals who bear them, either as collective knowledge (the "routines" that are non-written individual or collective action procedures [12] or personal knowledge (skills, crafts, "job secrets", historical and contextual knowledge of environment, clients, competitors, technologies, and socio-economic factors).

EXPLICITED KNOWLEDGE (KNOW-HOW)	**TACIT KNOWLEDGE EMBODIED BY INDIVIDUALS (SKILLS)**	
Collective knowledge (*Knowledge that can be though as objects)*	**Collective knowledge** (*Routines)*	**Personal knowledge** *(Private knowledge)*
- Knowledge formalized within documents and/or codified in knowledge-based systems and databases. - Knowledge embedded in automated management systems, conception systems, production systems, and products.	- Knowledge incorporated within models, and regular and predictable behaviors.	- People's abilities, - Professional knack, - Knowledge of company history, and decisional contexts, - Knowledge of the environment (customers, competitors, technologies), and socio-economic factors
Information source of knowledge for someone	**Defensive Routines** - Knowledge that is an obstacle to change **Constructive Routines** - Knowledge that favors innovation and change	**Specific knowledge belonging to each individual** - Knowledge that is a volatile intangible resource, which depends on the continuity of the presence of employees in the company

Table 1: The Two Main Categories of Company's knowledge

Postulate p2: Knowledge is not an object

Knowledge exists in the interaction between an interpretative Framework (incorporated within the head of an individual, or embedded into an artifact), and data. This postulate comes from the assumption emphasized by Tsuchiya [13] concerning knowledge creation ability. He emphases how organizational knowledge is created through dialogue, and highlighted how "commensurability" of the interpretative frameworks of the organization's members is indispensable for an organization to create organizational knowledge for decision and action. Here, commensurability is the common space of the interpretative frameworks (e.g. cognitive models or mental models) of each member. Tsuchiya states, "*It is important to clearly distinguish between sharing information and sharing knowledge. Information becomes knowledge only when it is sense-read through the interpretative framework of the receiver. Any information inconsistent with his interpretative framework is not perceived in most cases. Therefore, commensurability of interpretative frameworks of members is indispensable for individual knowledge to be shared*" (p. 89). In other words, we can say that tacit knowledge that resides in our brain results from the sense given, through our interpretative frameworks, to data that we perceive among the informations transmitted to us.

In a different way, Wiig [14] who highlights a discontinuity between information and knowledge describes this process clearly: "*the process by which we develop new knowledge uses prior knowledge to make sense of the new information and, once accepted for inclusion, internalizes the new insights by linking with prior knowledge. Hence, the new knowledge is as much a function of prior knowledge as it is of received inputs. A discontinuity is thus created between the received information inputs and the resulting new knowledge*" (p. 73).

To conclude, we can say that formalized and codified knowledge are not more than information. We consider this information as knowledge when members having a large commensurability of their interpretative frameworks commonly understand it. For example, such is the case for members having the same technical or scientific education, or members having the same business culture. In these cases, formalized and codified knowledge make the same sense for each member.

Postulate p3: Knowledge is linked to the action

From a business perspective, knowledge is essential for the functioning of value-adding processes. Activities contributing to theses processes use and create knowledge. Thus, the actions finalize the company's knowledge. This point takes into account the context and the situation, which allow using and creating knowledge. In particular, we must analyze the role of the decision-makers involved with these activities in order to achieve the company's missions. Therefore, knowledge is linked to their decisions, their actions, and their relations with the surrounding systems (people and artifacts).

The guiding principles

GAMETH® brings three main principles with respect to the modeling of the company, the knowledge analysis method and the process modeling approach.

Guiding Principle gp1: The modeling of the company

From the point of view of knowledge that she uses and creates, one can represent Company as a set of activities that make up the processes that are necessary to achieve the company's mission. Numerous researches in Business Process Management domains suggest the same approach.

The SADT method [15] inspires the activity model, presented in figure 3. However, there are two differences. First, it distinguishes two inputs: (i) the material transformed into a product by the activity; (ii) the data that inform on the status of this material and this product. Second, it includes the notions of produced knowledge and used knowledge.

Each activity focuses on the objective to reach. It transforms material into a product. It receives the data required for its well functioning and supplies the data for the functioning of other activities. It consumes financial resources and techniques. The activities use and produce specific knowledge (expertise and skills). They are subjected to constraints. These constraints can

either be external to the activity (imposed conditions such as costs, time, quality, specifications to be respected, technical, financial, human resources, and uncertainties related to delivery and the quality of the input materials), or internal to the activity, resulting from the limits of the admissible scope of the activity (zone of autonomy).

The activities can lead to malfunction, that is the gap between the expected and the obtained results. Malfunction is a symptom of either internal sources (directives, procedures, processes, particular action logic that may be maladapted to the situation), or external sources (inadequate materials, unreliable data, badly adapted resources and insufficient or erroneous knowledge). Malfunction can also result from intellectual activities related to the production of knowledge, technological activities related to the production process or purely administrative activities.

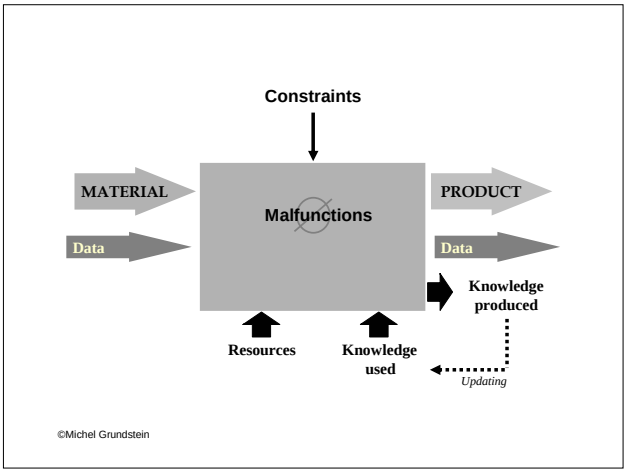

Figure 3: Knowledge-based Model of a Business Activity [7]

Guiding Principle gp2: The knowledge analysis method

The knowledge analysis method focuses on the so-called "sensitive processes". A sensitive process is a process, which represents the important issues, which are collectively acknowledged. These issues concern weaknesses in the process presenting a risk of not being able to meet the cost or time objectives, the required quality for the goods or services produced, obstacles to get over, challenges difficult to reach, goods and services that are strategic assets of the company. Creativity sessions, built upon the knowledge held by the responsible persons within the intervention domain, engender determining "sensitive processes". We describe the analysis method hereafter.

The problems and constraints can weaken the activities and may even endanger the process to which they are supposed to contribute. Therefore, the sensitive processes are submitted to a risk assessment. This assessment helps to determine the "critical activities". The problems related to these activities are called "determining problems". The relaxation of organizational constraints can lead to a rapid removal of these problems. The identification of the remaining determining problems leads to the identification of the knowledge that is required for their resolution. This knowledge can be qualified as "crucial knowledge" depending on its actual value.

Thus, the GAMETH® Framework does not involve a strategic analysis of the business objectives. It rather suggests focusing on the analysis of the knowledge that is relevant for the activities and insures efficiency of processes in concordance with the business missions.

Guiding Principle gp3: The process modeling approach

Besides the advantages of the process modeling approach highlighted in numerous publications, in the GAMETH® Framework the process modeling approach suggested in the phase ph2 follows constructivist logic. In order to distinguish potential crucial knowledge, the process modeling approach bases on the observation that processes, formalized through numerous procedures that prescribe action rules and operational modes, often differ from how these processes are perceived in actual world. Additionally, we observe that actors are often well aware of their part of the process, but ignorant with respect to the overall process in which this part has to operate.

The process modeling approach comprises formalization, with the stakeholders, of objectives relative to sensitive processes. A tree network representation called "Mission Tree" (cf. figure 4) is the support to represent these objectives. The interest of this representation is double: i) It allows stakeholder to have a common representation of the objectives to reach; ii) It is a way to identify sub-processes.

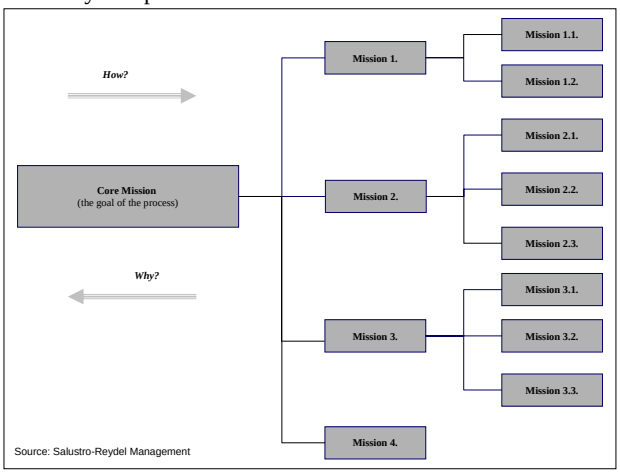

Figure 4: Mission Tree

Processes that allow representing how different services cooperate through activities and exchange information all along the time are modeled with a flow diagram called "Actigram" (cf. figure 5) This "Actigram" helps the cognitive engineer to pinpoint informal communication between actors. Moreover, this representation maps the interaction between individuals in terms of how they transfer their tacit and explicit knowledge in the sensitive process.

During the modeling phase, we understand the structure and the dynamics of processes, we ensure that stakeholders have a common understanding of processes, we derive the needs of stakeholders to support processes, we identify problems and critical activities, and we put in light communication networks between the actors.

The advantage of this constructivist approach is that it stimulates collective engagement, which is primordial for a successful outcome of a knowledge management initiative.

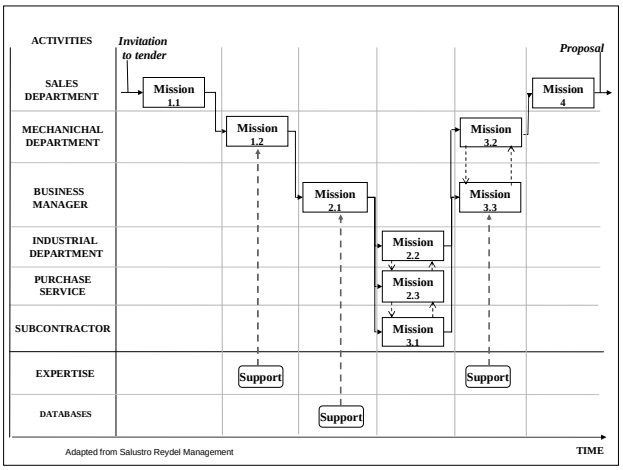

Figure 5: Actigram

The GAMETH® Framework's Characteristics

The GAMETH® Framework Approach presents three characteristics.

Characteristic c1: It is a problem-oriented approach

The problems are located, the required needs for knowledge that allow their resolution clarified, the knowledge is characterized, and then, the most adapted solutions to solve the problems are determined.

Characteristic c2: It is a process-centered approach, which connects knowledge to the action

The analysis does not rely to a strategic analysis of the company's goals. Instead, it consists to analyze knowledge needed by the value-adding activities of functional, production, business and project processes.

Characteristic c3: It is a constructivist approach

The approach allows collective commitment. The aim of this approach is to build from partial knowledge of the actors through their activities, the representation of the process. This representation allows identifying informal links between the actors that does not appear in the documents.

The GAMETH® Framework's Main Phases

In short, the GAMETH® Framework Approach consists of three main phases gathering the following steps:

Phase ph1: Project Framing

The first phase, called "Project Framing" specifies the project context, defines the domain and the limits of the intervention and determines the process, which is to be subjected to an in-depth analysis. The phase includes four steps: (i) Defining the domain and specifying the context of the operation; (ii) Framing operational processes, production processes and organizational entities (operational units, functional services, partners, clients) dealing with the production of goods and services; (iii) Modeling the domain of intervention (functional and structural models of the organizational entities, communication network model); (iv) Determining sensitive processes.

Phase ph2: Identification of the Potential Crucial Knowledge

The second phase, called "Identification of the Potential Crucial Knowledge", aims at distinguishing the problems that weaken the critical activities, i.e. the activities that might endanger the sensitive processes. The phase includes five steps: (i) Modeling sensitive processes; (ii) Assessing the risks to which the sensitive processes are exposed, and determining the critical activities for these processes; (iii) Identifying the constraints and malfunctions that weigh down on these activities; (iv) Distinguishing the determining problems; (v) Locating and characterizing the potential crucial knowledge.

Phase ph3: Determination of the Axes of a Knowledge Management Initiative

The third phase, entitled "Determination of the Axes of a Knowledge Management Initiative", is intended to define, localize and characterize the knowledge to be capitalized. It aims at answering the question: Who utilizes which knowledge during what phase in the sensitive process cycle? The phase includes five steps: (i) Clarifying the knowledge requirements for the resolution of the determining problems; (ii) Localizing and characterizing this knowledge; (iii) Assessing the value of this knowledge and determining the crucial knowledge; (iv) Outlining a project for the improvement of the decision-making and value-adding processes; (v) Determining the axes of a knowledge management initiative.

The Deliverable

The company's strategic orientation finalizes the approach, and the deliverable is an advisability analysis report, which notably includes:

- A repertory of the crucial explicit knowledge, associated with a document presenting a description and a classification of these knowledge.

- A repertory of agents, the bearers of crucial tacit knowledge that we are unable to convert into explicit knowledge, associated with a document presenting a description and a classification of this knowledge.

- An index of the agents possessing tacit knowledge, which is enable to be converted into explicit knowledge, associated with a descriptive card of their competences, the persons who might solicit them and the events that determine this solicitation.

- A document, defining tacit knowledge to share, completed with a grid, establishing the relations (formal and informal) between the agents - bearers of this knowledge, and the agents who might use them.

4. APPLICATIONS OF THE GAMETH® FRAMEWORK

We applied the GAMETH® Framework in different contexts. Hereafter we describe some case studies, and lessons we learned.

Case studies

The first example comes from the French Institute of Petroleum (IFP). The second example comes from the French National Center for Scientific Research (CNRS) Engineering Sciences Department (SPI).

The IFP has applied the GAMETH® Framework in order to set up a pragmatic approach to the capitalization of knowledge within the context of a research and development project. The

initiative has been taken by the Quality Direction and was carried out as part of a five-month internship within a M.Sc. program (Research Master) ending in June 2002. The objective of the research was to facilitate the identification of potential crucial knowledge through a selection of the documents, which would contain possibly valuable future assets as part of the final steps of a project.

Within the French National Center for Scientific Research (CNRS), the SPI department intended to launch a project in order to capitalize its internal information as well as the information produced by its attached research laboratories. The GAMETH® approach has been applied during a M.Sc research internship (Master research) ending in June 2003. The objective of the study was to facilitate the decision-making process through the identification of potential crucial knowledge (both tangible and tacit) required for the well functioning of a sensitive process within the SPI: the recruitment of engineers and technical personnel (IT). The main objective was to identify the critical activities and knowledge to be capitalized within the process.

The Lessons learned

The experiment at the IFP has shown the compatibility of the GAMETH® approach with the ISO 9004 (December 2000) recommendations. Furthermore, the alignment of the knowledge management discourse with the quality management discourse has turned out to be a key factor in the success of the project.

At a methodological level, the GAMETH® approach should be limited to one single process and involve at most 10 individual actors in order to be feasible within a six-month period.

The essential conditions for a successful implementation are: (i) include an initiation phase to familiarize the actors with the concepts of knowledge management; (ii) assure the involvement of (an important part of) the management, which is normal in any quality assessment approach; (iii) make sure that the GAMETH® approach is implemented by an individual familiar with the Enterprise.

The analysis of the results leads to a reasoned and shared vision of the sensitive process by the stakeholders of this process. This emphasizes also the impact of the process being analyzed on different levels of the organizational activities. Several problems result in fact from the interrelation of processes.

5. CONCLUSIONS

The GAMETH® Framework fits with the "Locating KM process" involved by the problem of capitalizing on company's knowledge.

The case studies have shown the relevance of the GAMETH® Framework leading to the construction of a "problem space", to the identification of stakeholders, and to the clarification of knowledge requirements.

Because of the constructivist approach logic, the involved actors contribute to the clarification of the problem and the elaboration of the solution. The approach crystallizes a learning process marked by the engagement of the stakeholders to learn together to articulate the problems and to develop the solutions. In this way, the approach acts as a catalyst of change.

6. REFERENCES

[1] Stewart, Th. A. (1991). Brain Power. How Intellectual Capital Is Becoming America's Most Valuable Asset, *FORTUNE* June, 1991.

[2] Stewart, Th. A. (2001). *The Wealth of Knowledge: Intellectual Capital and the 21tst century Organization*. New York: Currency Doubleday.

[3] Porter, M. E. (1985). *Competitive Advantage: Creating and Substaining Superior Performance*. New York: The Free Press.

[4] Tonchia, S., & Tramontano, A. (2004). *Process Management for the Extended Enterprise*. Berlin-Heidelberg: Springer-Verlag.

[5] Saad, I. (2005). *Une contribution méthodologique pour l'aide à l'identification et l'évaluation des connaissances nécessitant une opération de capitalisation*. Thèse de doctorat. Paris: Université Paris-Dauphine.

[6] Nonaka, I., Toyama, R., & Kono, N. (2000). SECI, *Ba* and Leadership: A Unified Model of Dynamic Knowledge Creation. In *Long Range Planning* 33 (2000, pp. 5-34). Elsevier Sciences Ltd.

[7] Grundstein, M. (2000). From capitalizing on Company's Knowledge to Knowledge Management. In D. Morey, M. Maybury, & B. Thuraisingham (Eds), *Knowledge Management, Classic and Contemporary Works* (chapter 12, pp. 261-287). Cambridge, Massachusetts: The MIT Press.

[8] Schreiber, A.Th., Akkermans, J.M., Anjewierden, A.A., de Hoog, R., Shadbolt, N.R., Van de Velde, W., & Wielinga, B.J. (2000). *Knowledge Engineering and Management. The CommonKADS Methodology*. Cambridge, Massachusetts: The MIT Press.

[9] Charlet, J., Manuel Zacklad, M., Kassel, K. &, Didier Bourigault, D. (2000). *Ingénierie des connaissances, Évolutions récentes et nouveaux défis*. Paris : Éditions Eyrolles et France Télécom-CENT.

[10] Grundstein, M. (1996). CORPUS, An Approach to Capitalizing Company Knowledge. *AIEM4 Proceedings*, The Fourth International Workshop on Artificial Intelligence in Economics and Management, Tel-Aviv, Israel, January 8-10, 1996.

[11] Polanyi, M. (1966). *The tacit dimension*. London: Routledge &Kegan Paul Ltd.

[12] Nelson, R.R. & Winter, S.G. (1982): *An Evolutionary Theory of Economic Change*. Cambridge, MA: Harvard University Press,.

[13] Tsuchiya, S. (1993). Improving Knowledge Creation Ability through Organizational Learning. In ISMICK'93 Proceedings, *International Symposium on the Management of Industrial and Corporate Knowledge* (pp. 87-95). Compiègne, France: University of Compiègne.

[14] Wiig, K. (2004). *People-Focused Knowledge Management. How Effective Decision Making Leads to Corporate Success*. Burlington, MA: Elsevier Butterworth-Heinemann.

[15] Marca, D,A. & McGowan, C, L. (1988). *SADT, Structured Analysis and Design Technique*. USA: McGraw-Hill, Inc.